INSULIN IN GENERAL PRACTICE

A CONCISE CLINICAL GUIDE FOR PRACTITIONERS

BY

A. CLARKE BEGG,

O.B.E., M.D., Ch.B. (Edin.), M.B. (Lond.)

Honorary Physician Swansea Hospital

(WITH FOUR DIAGRAMS)



LONDON

WILLIAM HEINEMANN

(Medical Books) Ltd.

1924

Made and Printed in Great Britain

PREFACE

THIS book is based on the experience of over seventy cases of Diabetes which I have had under my care in hospital, or have seen in consultation, since Insulin became available about eight months ago

A CLARKE BEGG

74, Walter Road,
Swansea

CONTENTS

DIAGNOSIS

TREATMENT

COMPLICATIONS

CONTENTS

DIAGNOSIS

TREATMENT

COMPLICATIONS

CHAPTER I

Is There Glycosuria?

The Examination of the Urine.

Although the cardinal sign of diabetes is an excess of sugar in the blood, attention is usually first directed to the disease by the appearance of sugar in the urine The clinical investigation naturally starts from this point, and the first question to be decided is whether glycosuria is actually present.

As it is frequently a matter of chance whether sugar is found in the urine or not, it is very desirable to have a specimen taken about an hour after a good meal. If sugar is being passed at all it is most likely to be present in the urine at this time.

There are many tests for glucose, but in ordinary qualitative clinical work Fehling's test

what we want to determine is whether it is present in pathological amount. Too delicate a test is apt to be misleading.

Fehling's Test

ith

a

The two solutions for the test should be kept separate Put about 1 inch of No 1 solution into a test tube and add an equal quantity of No 2, mix and boil for two minutes to test the Fehling If it remains clear, add a few drops of urine and boil In the absence of any reaction pour in more urine, until an amount equal to the amount of Fehling has been added Boil again, if no reaction, boil for two minutes and set aside to cool The reaction consists of the appearance of a yellow or yellowish red precipitate which may come down on the addition of a few drops of urine, or not until the full amount has been added The smaller the amount of urine re quired to produce a reaction the larger the amount of sugar present, so that the test done in this way is to a certain extent quantitative as well as qualitative If, even after standing for a few minutes, the solution remains perfectly clear, one can assume that no pathological amount of glucose is present

If the quantity of sugar is very small, the deposit may be a dirty greenish or dirty blue colour, and difficulty arises with these indefinite reactions There are many more or less elaborate methods for getting rid of "interfering" sub stances in the urine, and so allowing a doubtful reaction to be cleared up, but, without going into

heoretical considerations, attention to the follow ng points will usually serve to decide the question —

1 Ascertain whether the patient has been taking any medicine such as chloral, salicylates, carbolic, etc, which may be responsible for more or less definite reaction

2 If the specific gravity of the urine is very high, dilute with an equal volume of water and test again

3 If the specimen examined is a fasting one, have another taken about an hour after a

amined had been taken soon after a meal, get a fasting specimen If this gives a

passed, but only after meals A still better and very simple plan is to give the patient about 1 oz of glucose dissolved in water, and examine the urine passed an hour later A positive reaction will con

reaction

Lactose gives a similar reaction with Fehling's solution, but it occurs only in the urine of women during pregnancy and lactation. Levulose and pentose may give rise to trouble, but they are of rare occurrence.

If still in doubt try the fermentation test.

Fermentation Test.

If the urine is not acid, acidify with tartaric acid. Boil for ten minutes, then cool. Take about 50 c.c. of urine and mix with it a small piece of fresh yeast. Fill a Doremus ureometer tube wi [illegible] all air i [illegible] tube is [illegible] be filled and inverted in a small dish of the mixture.) Set the tube in a warm place for a couple of hours. If glucose be present some gas will have appeared at the top of the tube, if there is no gas one can assume that there is no appreciable amount of glucose. It may be well to put up a control tube containing a solution of glucose and yeast, and another tube containing normal urine and yeast. The former will show whether the yeast is active, while the latter will show whether the yeast itself gives off any gas. Performed in this way the test is one of the most reliable for the detection of glucose in the urine.

If glucose is present, we want to know how much is being excreted daily. There seems to be a deep-rooted opinion that the specific gravity of a urine gives fair indication of the amount of

sugar present, but this is very fallacious A high specific gravity may be due to a concentrated urine and contain little sugar, while one of low specific gravity may contain a good deal, the low specific gravity being due to deficiency of urea

For a quantitative test it is necessary to get a twenty four hours specimen Instruct the patient to pass urine at say 8 a m, but not to keep what is passed During the next twenty four hours, up to and *including* 8 a m the following morning, he is to pass all urine into a clean jar or other vessel He must measure the total quantity and bring to the doctor an ordinary medicine bottle full of the mixed urine It is worth while insisting on the bottle being thoroughly clean

There are many methods of doing the quantitative test, and it is difficult to say which is the most simple and at the same time fairly reliable I think that the Fehling s method is quite reliable enough for clinical work It has the advantage that the solutions are always to hand and that no elaborate apparatus is required

Quantitative Estimation of Sugar
Fehling's Method

Place 10 c c. of Fehling's solution (5 c c No 1 + 5 c c No 2) in a small porcelain basin, add water up to about 50 c c, and bring to the boil over a spirit lamp or bunsen flame While this is heating dilute the urine 1 in 20, *i e*, 5 c c urine to 95 c c water Fill a burette graduated in c cs with the diluted urine, and when the Fehling's

solution is boiling, run it in slowly Stir the whole time and never add more unless the *solution is boiling vigorously* Cuprous oxide is thrown down, and the reaction is complete when all the blue colour is discharged from the solution It is
when this poir
one is able to
the dish so tha
through a layer of the fluid If a burette is not available, the diluted urine may be withdrawn from a 100 c c cylinder by means of a glass pipette and gradually added to the urine If this is done the number of c c used can be calculated by finding how many c c are left in the 100 c c measure when the reaction is complete

The calculation is very simple Divide 100 by the number of c c used, which gives the *percentage of sugar, or which is the same thing* the number of grams in each 100 c c Knowing the total amount of urine, the number of grams of sugar passed in the twenty four hours is easily calculated For example suppose 10 c c of diluted urine has been used, and *that the total* quantity of urine for the twenty four hours is *three pints or* 1,700 c c, *the calculation* will be —

$\frac{100}{10} = 10$ *i e*, the urine contains 10 per cent of sugar or 10 grams per 100 c c The total quantity was 1,700 c c and 10 per cent of this = 170, which is the total number of grams of sugar in twenty four hours

CARWARDINE'S SACCHAROMETER

inexpensive and may be obtained from any instrument maker, with full directions It is a very convenient clinical method for quantitative estimation, but is not very accurate

It is convenient at this stage to describe the tests for acetone and diacetic acid A knowledge of these tests is essential in the diagnosis and treatment of diabetes

TEST FOR ACETONE (ROTHERA)

The urine should be as fresh as possible for both these tests To about 2 inches of urine in a test tube, add a few drops of freshly prepared
pared
nitro
Add
with
crystals of ammonium sulphate Invert the tube several times and allow to stand A violet colour, similar to a permanganate solution, indicates the presence of acetone A rough estimate of the amount present may be made by noting the rapidity with which the colour appears and the depth of the colour If much is present, the colour appears almost immediately and is very deep in a few minutes If little is present, the colour appears slowly and is little more than a

tinge If there is no colour after fifteen minutes, the test is completely negative The amount present may be roughly recorded by a number of plus signs, thus, acetone + + + means that the colour has appeared within half a minute, acetone + + that it has appeared within two minutes, and acetone + that there is only a later colouration

TEST FOR DIACETIC ACID (GERHARDT)

Pour about an inch of urine into a test tube, and add drop by drop a solution of weak *perchloride* of iron *Ordinary liquor ferri perchlor* diluted three and four times is about right If there is a precipitate of ferric phosphate, continue adding until a precipitate ceases to appear The solution turns a deep burgundy colour if diacetic acid is present This colour disappears on boiling, which serves to differentiate it from a somewhat similar colour produced in patients who are taking salicylates, etc

It is sometimes advised that the phosphate precipitate should be filtered off before completing the test, but this is seldom necessary

There has been much discussion as to the exact significance of these tests It seems probable that all urines which give a positive reaction for acetone contain diacetic acid also, but not in sufficient amount to give a reaction with perchloride of iron *The practical point is* that a positive Gerhardt s test is of much graver significance than a positive Rothera

While examining the urine, it is always well

to test for albumin, and if present it may be advisable to look for casts, estimate the amount of urea and make other investigations to determine the efficiency of the kidneys

We have now established the presence of glycosuria and have found out how much sugar is being passed daily

CHAPTER II

Are There Clinical Signs of Diabetes?

The Examination of the Patient

Needless to say, the presence of sugar in the urine does not necessarily indicate diabetes The history of the case must be gone into and a thorough clinical examination carried out

The first thing to determine is whether there is any indication of diseases, other than diabetes, which may be producing the glycosuria The principle ones to look out for are —

1 Exopthalmic goitre and diseases of the thyroid gland Under this heading it would be well to inquire whether the patient is taking any preparation containing thyroid
2 Cerebral tumour
3 Acromegaly
4 Gall stones
5 New growth affecting the pancreas

These can usually be excluded, but sometimes present difficulties Recently I had a case under my care illustrating the difficulties in connection with new growths

CASE 1—Woman, aged 60 Five years history of indigestion and diabetes Has increasing weakness and thirst and has lost much weight Looks ill Passing 45 grams of sugar daily, acetone +, no diacetic acid Trace of albumin Fasting blood sugar, 360 mgr per 100 c c. Dietetic treatment not successful, but with the help of insulin she became sugar and acetone free, had a normal blood sugar, gained weight and felt well She remained very well for two months, when she was re admitted feeling very weak and suffering a great deal

If these diseases can be excluded, the patient is suffering from either true diabetes mellitus or renal glycosuria, and we must look briefly at the clinical signs and symptoms of the two conditions.

DIABETES MELLITUS.

The more important clinical signs and symptoms of true diabetes are :—

Aetiology.

Age. No age is exempt Speaking very generally, the younger the age the more severe is the disease, but this is by no means invariable.

Sex. Both sexes In my series of cases women preponderate.

Heredity. This is an important factor. I have had two brothers, both young men, who showed the first symptoms of the disease at about the same time, and in a good many of my cases there was a definite family history in one or other parent.

Race Jews are particularly liable

Excessive ingestion of carbohydrates This is usually stated to have no definite influence, but I have had many cases in which it appeared to be an important factor Case 3 is a striking instance The prognosis appears to me to be decidedly better than usual in these cases

Other illnesses and nervous shock, etc I have seen three cases where the first symptoms followed influenza, and a considerable number where nervous shock and a period of unusual worry appeared to be predisposing causes

Symptoms

Onset is usually gradual, but may be quite sudden More commonly a sudden onset is due to nervous shock, but Case 17 illustrates a remarkably sudden onset without apparent cause

Polyuria Necessary for the excretion of large quantities of sugar It is usually an early symptom

Thirst Associated with preceding

Pruritus Usually about the vulva in women and about the glans penis in men *It is a prominent symptom in fully 90 per cent of my female cases, and is frequently the symptom for which advice is first sought I consider it the most constant single symptom of diabetes in women

Loss of weight Almost invariably present and usually an early symptom

Weakness and loss of energy Very common

Appetite Usually stated to be greatly in

creased, but I have not found it a common symptom

Sexual function Impotence is a common symptom and frequently an initial one

Physical Signs

General appearance Often look pinched, depressed and pale

Skin Dry and harsh

Tongue In severe cases dry and red, the so called "raw beef tongue

Bowels Apart from complications, invariably constipated

Cardio vascular system In old standing cases there are often signs of myocarditis Pulse usually rapid Breathlessness and some œdema common Arterial degeneration is very common in cases of any standing and is usually much

or absent

Muscles Flabby

Renal Chronic nephritis is very common It is stated in many text books that a trace of albumin is often present, but is of no great

of the urea content of urine and blood, too often reveals markedly inefficient kidneys

The investigation of the urine is discussed fully in the previous chapter.

Blood. The question of blood sugar is dealt with in the next chapter. Lipæmia is sometimes found and there is frequently some degree of simple anæmia.

Complications.

The complications of acidosis, coma, gangrene and infections are discussed in succeeding chapters.

Other complications are :—

Nervous System.

Peripheral neuritis, with which the diminution or loss of knee jerk is associated, is very common. It has the usual symptoms of tinglings, numbness, pain, loss of muscular power, etc., and may take the form of the so-called diabetic tabes. Perforating ulcers are not uncommon.

Eye. Cataract is very common and usually bilateral. Diabetic retinitis and retrobulbar neuritis also occur.

Respiratory System.

Pulmonary tuberculosis is prone to occur especially in young patients. It is in this connection insulin has a special value, inasmuch as it allows a much more generous diet.

Pneumonia may occur and is a very serious complication.

It must always be remembered that one of the

complications may be the first indication of the disease, and that the occurrence of any one of them should lead to an examination of the urine Again, in many cases there are few signs or symptoms, and the diagnosis is made by accident in the course of the routine examination for life insurance or one of the services It should be an

ine in any case
where there is
ry examination

Early diagnosis is of inestimable importance

Renal Glycosuria

Aetiology

This is unknown It is probably of much more frequent occurrence than is generally recognised, as it is only by the modern methods of blood examination that it can be diagnosed with certainty

Symptoms and physical signs

There are no symptoms except those due to depression and anxiety about their supposed serious condition Too often they have been told that they are suffering from diabetes, and put on a strict diet which only succeeds in further depressing their general health The condition is usually discovered accidentally through routine examination of the urine

The sole physical sign is that the urine contains sugar This may occur only after each meal or may be constantly present It depends on the

height of their "leak point If this is only a little below normal, sugar is passed only after meals, if very low it is passed continuously The quantity passed is usually small One very important rule, to which I have not seen any exception, is that *there is never any acetone in the urine* The appearance of acetone in the urine along with sugar would appear to exclude a diagnosis of renal glycosuria The whole subject is further discussed in the next chapter

Prognosis

So far as our present knowledge goes this is absolutely favourable The condition does not appear to shorten life or to impair health The diagnosis between ave disease of true

The following case which I saw recently in consultation may be taken as typical of the usual history and the clinical findings —

Case 2—*Man aged 34 Complaint* diabetes. History did not know that there was anything wrong

dieting
depressed
rather thi
urine contained 1 6 per cent of glucose and quantity passed in twenty four hours was 28 2 grams No acetone or diacetic acid A sugar tolerance test was

done which showed that his blood sugar behaved normally, and I was able to assure him that there was nothing to worry about

It will be seen from the above that it may be possible to differentiate between renal glycosuria and diabetes, with a fair degree of certainty, from clinical symptoms and signs If the patient has been passing sugar, for many years without any deterioration of health, if dieting has little effect on the output of sugar, and if all the other symptoms and signs of diabetes are absent, it is almost certain that he is a case of renal glycosuria On the other hand, if the urine contains acetone or diacetic acid in addition to sugar, it is almost certain to be a case of true diabetes

The only certain method, however, is by examination of the blood

CHAPTER III

Is The Blood Sugar Normal?

The Examination of The Blood

All the recent advances in the pathology, diagnosis and treatment of diabetes depend on our ability to estimate accurately the amount of sugar present in the blood under varying conditions This used to be a difficult and somewhat complicated process, necessitating the use of costly instruments and demanding a moderate degree of technical skill

The profession owes a debt of gratitude to Maclean for his simple method of estimating the blood sugar Every physician should, of course, be familiar with it, and the average general practitioner who is prepared to measure solutions accurately, and to devote a little time to the subject, should have no difficulty in carrying out the test The time required for the test is from twenty minutes to half an hour, and I am quite satisfied after seven or eight months constant use of it that the test is a very accurate one

Messrs Allen and Hanbury s Ltd supply an outfit comprising all the apparatus and reagents required along with directions for carrying out the test

Estimation of Blood Sugar by Maclean's Method

General Principle of the Method

The preliminary test is to determine the amount of free iodine which is liberated from 2 c c of the special copper iodine solution by excess of sulphuric acid This is done by titration with a standard solution of sodium thiosulphate, using starch as the indicator The test proper is —

1 To get rid of protein in 0 2 c c blood by heating with acid sodium sulphate solution adding dialysed iron and filtering through starch free filter paper

2 A definite quantity, usually 20 c c, of the clear filtrate is tested quantitatively for sugar

3 This is done by adding 2 c c of the special copper iodine solution, boiling for a certain length of [illegible] test

4 The difference between the amount of free iodine now present (as shown by the amount of thiosulphate solution used) and the amount of free iodine which was present in the preliminary test, represents the amount of sugar which was contained in the definite quantity of blood filtrate which was taken By means of a table the number of milligrams of glucose per 100 c c of blood, which this figure indicates, is seen at a glance

Apparatus required

1 One special Maclean pipette to contain 0·2 c c blood
2 Two Erlenmeyer flasks of 100 c c capacity made of hard, heat resisting glass, one to be provided with a rubber cork with a hole in the centre through which passes a glass tube narrowed at lower end (This is to minimise evaporation when boiling)
3 One 100 c c graduated flask or cylinder
4 One special pipette to hold 23 8 c c
5 One 1 c c pipette graduated in 1/100th c.c. (not essential)
6 One 1 c c ordinary pipette
7 One small filtering funnel
8 Whatman s No 1 filter paper, diameter 11 cms
9 One small cylinder or test tube, marked at 20 c c
10 One 20 c c ordinary pipette
11 Two 2 c c ordinary pipettes
12 One 200 c c flask
13 One 5 c c ordinary pipette
14 One burette of 25 c c. capacity, graduated in 1/10th c c., with stand
15 Some triangular surgical needles or preferably a trigger lancet
16 Bunsen burner, tripod stand with wire gauze

Stock Solutions, etc , required

1 Some packets of sodium sulphate, each containing 15 grams
2 1 oz pure acetic acid, in drop bottle
3 2 ozs dialysed iron solution
4 4 ozs special alkaline copper iodine solution
5 4 ozs 25 per cent sulphuric acid
6 8 ozs N/10 solution of sodium thiosulphate
7 1 oz pure soluble starch powder

Solutions for use

(Which should be made up fresh when required)

1 *Acid sodium sulphate solution* Put about 60 or 70 c.c of distilled water in the 100 c c graduated flask or cylinder, dissolve in this a packet (15 grams) of sodium sulphate and make up the volume with distilled water to 100 c c Then add 0 1 c c pure acetic acid This can be done with pipette (No 5 on list of apparatus) or more simply by keeping the acetic acid in a drop bottle ascertain by experiment how many drops are required to make up 2 or 3 c c, and calculate from this the number of drops in 1/10th of a c c In the drop bottle which I use 4 drops is the *requisite amount*

2 *N/400 solution of sodium thiosulphate* Put some distilled water into the 200 c c flask, add by means of the ordinary 5 c c pipette, 5 c c. of the N/10 sodium thiosulphate solution and make

The dialysed iron solution, the special alkaline copper iodine solution and the 25 per cent sulphuric acid solution, are ready for use and keep good for months They should be kept away from the light

Directions for Carrying Out Test

Preliminary Test to Standardise Copper Solution

In any small clean flask or beaker put about 5 c.c acid sodium sulphate solution and add to it *exactly* 2 c c of the copper solution by means of one of the ordinary 2 c c

Appara

1 One special Maclea
blood.
2 Two Erlenmeyer fl.
hard, heat resistin
with a rubber co
through which 1
lower end. (Th
when boiling)
3 One 100 c c gradu
4 One special pipette
5 One 1 c.c. pipette
essential)
6 One 1 c.c. ordinar
7 One small filterin
8 Whatman s No 1
9 One small cyl nd
10 One 20 c c. ord
11 Two 2 c.c. ordin
12 One 200 c c fle
13. One 5 c c. ord n
14 One burette
1/10th c.c
15 Some triangu
trigger lanc
16. Bunsen burn

Stoc

1 Some pacl.
15 grams
2 1 oz pure
3 2 ozs dil
4 4 ozs sp
5 4 ozs 2
6 8 ozs N/1
7 1 oz pu e

blood The point of Maclean's special pipette is placed in the drop of blood, the pipette itself being held with the distal end inclined downwards, and the blood flows into it by capillary attraction assisted by gravity. When the blood reaches the 0 2 c.c. mark, the pipette is removed, its outside

times till the last traces of blood are removed.

Even with the pipette thoroughly clean there are sometimes difficulties, and I think the following modification has some advantages. After the finger is pricked let the blood drop into a clean watch glass, and by putting a small rubber teat on the pipette, *suck* the blood up to the mark.

If the blood has to be taken at the patient's home, it is better to withdraw a few c c of blood from a vein into a test tube containing a very little finely powdered potassium oxalate. From this 0 2 c c blood can be removed for the tes This method has the advantage that if anyt goes wrong with the first test there is

use wash out with the alcohol and ether, and If the 0 2 c c. mark gets of a soft lead pencil)

3 After addition of the blood replace rubber cork and shake to mix thoroughly Heat the flask over the bunsen until the mixture darkens and a few bubbles appear, showing that the fluid is approaching boiling point Remove flask and

contents of the flask can be poured in at one time The filtrate should be water clear

4 By means of the 20 c c pipette *exactly* 20 c c of the filtrate is transferred to the other small Erlenmeyer flask the one without a cork. To this is added *exactly* 2 c c of the special copper solution and the mixture boiled in the open flask for exactly six minutes from the time that brisk boiling commences The height of flame for this process must be regulated previously For very accurate work Maclean recommends a special apparatus for the purpose, but for ordinary clinical work the following method will suffice Put 20 c c acid sodium sulphate solution and 2 c c copper solution into the Erlenmeyer flask and find by experiment what size of flame is necessary to bring the mixture to vigorous boiling in about 1 minute and 40 seconds This is the correct

and plunge it up to its neck in a large jug of cold water Thorough cooling is essential

5 To the cooled solution add 2 c c 25 per cent sul phuric acid and agitate the flask, gently at first

and afterwards more vigorously, until about a minute after all effervescence has ceased

6 The burette is filled again with the sodium thiosulphate solution up to the zero mark, and then run into the flask slowly till the yellow colour has almost gone Add a few drops starch solution, and go on dropping in the thiosulphate solution till the blue colour is completely discharged, as described in preliminary test When the end point is reached, read off the number of c c of thiosulphate solution which has been used

7 *Calculation of Result* The number of c c of thiosulphate used in the test proper is deducted from the number of c c used in the preliminary test Look up the resulting number in the table below, and read off the number of mgr glucose in 100 c c blood

For example, suppose the preliminary test used 10 8 c c sodium thiosulphate solution and the test proper used 8 6 c.c, then 10 8 — 8 6 = 2 2 c c, and on reference to the table it is seen that this amount of thiosulphate solution represents 118 mgr per 100 c c of blood

This table only holds good when 20 c c of the [illegible]

solution, while the filtration of the blood mixture is in progress

TABLE GIVING THE NUMBER OF MILLIGRAMS OF GLUCOSE PER 100 c c BLOOD EQUIVALENT TO THE AMOUNT OF N/400 SODIUM THIOSULPHATE SOLUTION

(When 20 c c Blood Filtrate is used)

N/400 Thiosulphate	Mgr Glucose per 100 c c	N/400 Thiosulphate	Mgr Glucose per 100 c c	N/400 Thiosulphate	Mgr Glucose per 100 c c
c c		c c		c c	
0.12	13	2.22	118	4.24	218
0.25	25	2.35	125	4.37	225
0.38	31	2.44	131	4.49	231
0.50	37	2.61	137	4.62	237
0.62	43	2.74	143	4.74	243
0.78	50	2.86	150	4.87	250
0.86	56	2.99	156	4.99	256
0.99	62	3.11	162	5.12	262
1.13	68	3.24	168	5.24	268
1.26	75	3.36	175	5.37	275
1.39	81	3.49	181	5.49	281
1.53	86	3.61	187	5.62	287
1.67	93	3.74	193	5.74	293
1.80	100	3.87	200	5.87	300
1.94	106	3.99	206	5.99	306
2.07	112	4.12	212	6.12	312

fully discussed]

Before explaining how the blood examination differentiates between true diabetes and renal glycosuria, it is necessary to have a general idea of normal carbohydrate metabolism and the alterations which take place in disease

All ingested carbohydrates are converted into glucose and absorbed into the blood A certain amount is used up by the muscles and other tissues, while the remainder accumulates in the blood up to a certain point, when the surplus passes to the liver (and to a certain extent to the muscles) where it is stored as glycogen As a result the blood sugar rapidly returns to the normal level When there is a further call for sugar on the part of the muscles for the production of energy the blood sugar tends to be lowered still further, but the glycogen in the liver is reconverted into sugar, passes into the blood, and makes good the deficiency

The normal sugar content of fasting blood is from 80 to 120 mgr per 100 c c After a meal containing carbohydrates the amount rapidly increases, but in normal persons it rarely goes higher than 180 mgr before the storage mechanism comes into action, the surplus sugar passes to the liver and the blood sugar comes down to the fasting level fairly rapidly No sugar is excreted, as none passes into the urine until the blood sugar rises to somewhere between 180 and 200 mgr The exact point at which the kidneys begin to excrete sugar varies, and is called the "leak point" In normal persons

therefore, the sugar storage mechanism comes into play before the blood sugar has become high enough to reach the leak point of the kidneys

In diabetes, owing to the inability of the tissues to use the blood sugar properly and to the defective sugar storage mechanism, the level of the blood sugar after a carbohydrate meal goes on increasing until the leak point is reached and glycosuria results In severe, or even moderately severe cases, the blood sugar level may be constantly above the leak point, so that glycosuria is constant We now know that in most cases this disturbance of carbohydrate metabolism is caused by a diminished supply of insulin, the internal *secretion of the islands of* Langerhans in the pancreas

In renal glycosuria, carbohydrate metabolism is normal, but the leak point of the kidneys is unusually low If this leak point is about 140 mgr sugar will appear in the urine only after meals, while if the leak point is about 100 mgr glycosuria may be constantly present

To impress these facts on my own mind I evolved some rather crude diagrams, which I hope may help those who are not familiar with the subject to grasp the general principles of the process

Diagram 1 illustrates normal carbohydrate metabolism The larger cylinder, graduated in milligrams per 100 c c, represents the blood sugar, while the smaller one represents the liver containing glycogen A pipe (*a*), in which is a

tap (*b*), is shown connecting the two cylinders On the other side of the blood sugar cylinder an out flow pipe (*c*) [illegible] the kidneys [illegible] shown an inflo[illegible] assume that the normal fasting blood sugar level is 100 mgr After a carbohydrate meal sugar is poured into

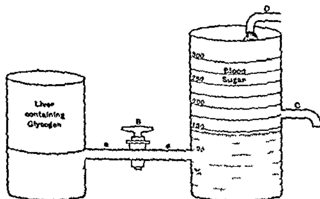


DIAGRAM 1 —Normal Carbohydrate Metabolism

the blood from inflow pipe (*d*), and the level of the blood sugar in the cylinder consequently rises As it does so, however, more and more of the sugar passes along pipe (*a*), to the liver and is stored as glycogen, so that the level of the blood sugar never rises higher than 110 to 150 mgr. Thus the leak point is never reached and there is no glycosuria This storage mechanism can only

take place if there is an adequate supply of natural insulin available, and insulin may be regarded as the hand needed to keep tap (*b*) open, so that surplus sugar from the blood may pass to the liver.

Diagram 2 shows the altered carbohydrate metabolism in diabetes. After a carbohydrate

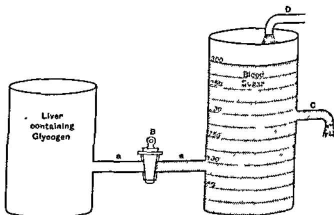


DIAGRAM 2.—Carbohydrate Metabolism in Diabetes.

meal, sugar is poured into the blood from inflow pipe as before, and the level of the blood sugar rises, but owing to the absence or a diminution in the supply of insulin, the tap (*b*) remains more or less closed. The level of the blood sugar goes on rising until the *leak point of the kidneys* is reached or passed, and sugar is excreted in the urine. As previously stated, the blood sugar in

diabetes is often constantly above this point, rising higher immediately after food but never falling below it, so that glycosuria is constant

Diagram 3 illustrates renal glycosuria Metabolism is normal, as there is an adequate supply of insulin which keeps tap (*b*), open The only departure from normal is that the leak point of

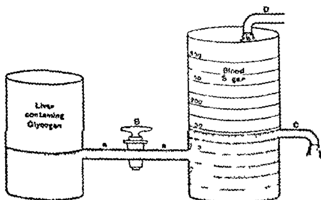


DIAGRAM 3 —Carbohydrate Metabolism in Renal Glycosuria.

the kidneys (out flow pipe *c*) is abnormally low Although the blood sugar never rises above normal level, there is either constant or intermittent glycosuria

We are now in a position to understand how the blood sugar test is used to differentiate renal glycosuria from true diabetes A single test may

CHAPTER IV

PRINCIPLES OF DIETETICS

FOOD is necessary for two purposes —

1 To provide material for the growth and repair of the fabric of the body

2 To provide a supply of potential energy for conversion into heat and work

All the organic constituents of food may be roughly divided into three great classes —

1 Proteins
2 Carbohydrates
3 Fats

1 *Proteins* These consist of gluten, myosin, etc, and may be obtained from either animal or vegetable foods The manufacture and repair *of the tissues of the body can only be done by* protein, neither carbohydrates nor fats can take any share in it

On the other hand, protein is able to take the place of carbohydrates and fats in the production of heat and energy In other words protein is the one indispensable organic constituent of food Without it repair of the body tissues cannot take place and life would soon cease

2 *Carbohydrates* These consist mainly of sugar and starches, and are for the most part obtained from vegetable food Along with the fats they provide the necessary energy and heat

3 *Fats* This group consisting of fat, butter and natural oils is obtained from both animal and vegetable sources Fats and carbohydrates are more or less complementary to each other, both are able to provide energy and heat while both are unable to make good tissue waste

An ordinary diet should consist of a mixture of these three great groups, but the actual proportions may and do vary within wide limits, depending on race, climate, the food which is most really available and least costly The one essential constituent, however, is protein, and our next enquiry must be how much of it is necessary daily Unfortunately physiologists are unable to give us definite information, and most of our data must be obtained from the general experience of mankind, and the average amount actually found to be consumed by the average man Obviously the amount necessary depends to a considerable extent on age, as the growing boy has to have sufficient for growth as well as maintenance Body weight would appear to be a factor, as the larger the body, the more material for maintenance would appear to be required The amount of muscular work is another factor, although its precise influence on the amount of protein required is still in dispute The *minimum* amount of protein required is given by various

authorities as from $\frac{3}{4}$ gram to 1 gram per kilo gram (2 2 lbs) of body weight The average amount below which protein should not fall may probably be taken as 2 grams for a child, $1\frac{1}{2}$ grams for an adult and 1 gram for an elderly man or woman In round figures the average minimum amount for a man leading an ordinary life should not be less than 80 grams

The amounts of carbohydrate and fat may be varied within wide limits, so long as between them they bring the total energy value of the diet up to the necessary standard

It must be noted, however, that carbohydrates alone would be very bulky, while too large a proportion of fat tends to produce disorders of the digestion The usual proportion in an ordinary diet is 6 of carbohydrate to 1 of fat

The standard amount of the constituents of an *average diet are given by Hutchinson* as follows —

Carbohydrate	450 grams
Protein	100
Fat	75

The amount of potential energy contained in the various ingredients of food is measured by the amount of heat which it produces on complete combustion The standard is the calorie which is the amount of heat required to raise one litre of water 1 C It is estimated roughly that 1 gram of fat produces 9 calories, while 1 gram of carbohydrate or 1 gram of protein produces only four calories The method of ascertaining

the total number of calories in any article of diet is very simple. Suppose 1 oz. of oatmeal consists of 18 grams carbohydrate, 4 grams protein and 2 grams fat, the calculation of total calories would be as follows:—

Carbohydrate	18 × 4 = 72 calories
Protein	4 × 4 = 16
Fat	2 × 9 = 18
	Total 106

The next question is how many calories are required daily? This is based on the body weight and a usual figure given is 25 to 30 calories per day for every kilo of body weight for *a man at rest*. For *instance a man weighing 10* stone (64 kilos) would require as a minimum from 1,600 to 1,900 calories per day while at rest. Other authorities make much more elaborate calculations, taking into account not only weight, but height, age and sex. These elaborate calculations are of doubtful practical value. For ordinary purposes a man or woman of average physique, doing ordinary work, requires usually from 2,500 to 3,000 calories daily, and the minimum should not come much below the lower figure. Working out the caloric value of the diet of the average man given above would result as follows:—

Carbohydrate	450 grams	× 4 = 1,800 calories
Protein	100	× 4 = 400
Fat	75	× 9 = 675
		Total 2,875

authorities as from ¾ gram to 1 gram per kilo gram (2 2 lbs) of body weight The average amount below which protein should not fall may probably be taken as 2 grams for a child, 1½ grams for an adult and 1 gram for an elderly man or woman In round figures the average minimum amount for a man leading an ordinary life should not be less than 80 grams

The amounts of carbohydrate and fat may be varied within wide limits, so long as between them they bring the total energy value of the diet up to the necessary standard

It must be noted, however, that carbohydrates alone would be very bulky, while too large a *proportion of fat tends to produce* disorders of the digestion The usual proportion in an ordinary diet is 6 of carbohydrate to 1 of fat

The standard amount of the constituents of an average diet are given by Hutchinson as follows—

Carbohydrate	450 grams
Protein	100
Fat	75

The amount of potential energy contained in the various ingredients of food is measured by the amount of heat which it produces on complete combustion The standard is the calorie which is the amount of heat required to raise one litre of water 1 C It is estimated roughly that 1 gram of fat produces 9 calories, while 1 gram of carbohydrate or 1 gram of protein produces only four calories The method of ascertaining

the total number of calories in any article of diet is very simple Suppose 1 oz of oatmeal consists of 18 grams carbohydrate, 4 grams protein and 2 grams fat, the calculation of total calories would be as follows —

Carbohydrate	18×4 = 72 calories
Protein	4×4 = 16
Fat	2×9 = 18
	Total 106

The next question is how many calories are required daily? This is based on the body weight and a usual figure given is 25 to 30 calories per day for every kilo of body weight for a man at rest For instance a man weighing 10 stone (64 kilos) would require as a minimum from 1,600 to 1,900 calories per day while at rest Other authorities make much more elaborate calculations, taking into account not only weight, but height, age and sex These elaborate calculations are of doubtful practical value For ordinary purposes a man or woman of average physique, *doing ordinary work, requires usually* from 2,500 to 3 000 calories daily, and the minimum should not come much below the lower figure Working out the caloric value of the diet of the average man given above would result as follows —

Carbohydrate	450 grams	×4 = 1 800 calories
Protein	100	×4 = 400
Fat	75	×9 = 675
		Total 2 875 "

authorities as from ¾ gram to 1 gram per kilo gram (2 2 lbs) of body weight The average amount below which protein should not fall may probably be taken as 2 grams for a child, 1½ grams for an adult and 1 gram for an elderly man or woman In round figures the average minimum amount for a man leading an ordinary life should not be less than 80 grams

The amounts of carbohydrate and fat may be varied within wide limits, so long as between them they bring the total energy value of the diet up to the necessary standard

It must be noted, however, that carbohydrates alone would be very bulky, while too large a proportion of fat tends to produce disorders of the digestion The usual proportion in an ordinary diet is 6 of carbohydrate to 1 of fat

The standard amount of the constituents of an average diet are given by Hutchinson as follows —

Carbohydrate	450 grams
Protein	100 ,,
Fat	75

The amount of potential energy contained in the various ingredients of food is measured by the amount of heat which it produces on complete combustion The standard is the calorie which is the amount of heat required to raise one litre of water 1 C It is estimated roughly that 1 gram of fat produces 9 calories, while 1 gram of carbohydrate or 1 gram of protein produces only four calories The method of ascertaining

the total number of calories in any article of diet is very simple Suppose 1 oz of oatmeal consists of 18 grams carbohydrate, 4 grams protein and 2 grams fat, the calculation of total calories would be as follows—

Carbohydrate	$18 \times 4 = 72$ calories
Protein	$4 \times 4 = 16$
Fat	$2 \times 9 = 18$
	Total 106

The next question is how many calories are required daily? This is based on the body weight and a usual figure given is 25 to 30 calories per day for every kilo of body weight for a man at rest For instance a man weighing 10 stone (64 kilos) would require as a minimum from 1,600 to 1,900 calories per day while at rest Other authorities make much more elaborate calculations, taking into account not only weight, but height, age and sex These elaborate calculations are of doubtful practical value For ordinary purposes a man or woman of average physique, doing ordinary work, requires usually from 2,500 to 3 000 calories daily, and

the

ue of

ro

result as follows—

Carbohydrate	450 grams	$\times 4 = 1$[illegible]	
Protein	100	$\times 4 =$	400
Fat	75 ,,	$\times 9 =$	675
			Total 2 875 ,,

to follow his ordinary occupation. The following case illustrates this :—

Has always been a small eater, and not fond of sugar and sta

sugar,

hours.

The fas

c c. I was of opinion that he was a moderately severe *case, and would require insulin, but advised his doctor to* put him on the standard diet first and see the effect In two days he was sugar free, and up till now (six weeks later) has remained both sugar and acetone free, is gaining weight and feels well Blood sugar not examined since

Where the standard diet is successful, it is a good plan to make the patient have a fast day or semi-fast day once a week to rest the pancreatic cells. When a man is employed during the week, Sunday is the most convenient day for the purpose, as it is undesirable and impracticable to ask anyone to fast on a day when engaged in any active occupation.

The schemes of diatet which are available, apart from the may be summarised.

At the present time to ind the use of W "ladd acq r tolerance

reached with the "standard' diet Against this, however, the "ladder diet' involves at least one month in bed in a hospital or similar institution, and another month off work and if ultimately the case is found to be unsuitable for dietetic treatment alone, much valuable time has been lost The 'standard' diet has the advantage that, in mild or moderate cases it may be used while the patient is following his ordinary occupation, and in more severe cases where lying up is required, less strict supervision suffices and a much shorter time is necessary to decide whether insulin is required or not

For these reasons I advise that cases should first be tried on the "standard diet except those who have marked denutrition or acidosis The latter should be put on insulin treatment at once

CHAPTER VI

The Principles of Insulin Treatment

It is unnecessary to go into the well known history of the discovery of insulin by Dr Banting, of Toronto

For a good many years it has been known that normal carbohydrate metabolism depended on the presence in the blood of the internal secretion of the cells [illegible] pancreas [illegible] and their [illegible] absent The actual cause of the degeneration is not known, and possibly is not the same in all cases Diabetes is therefore a "deficiency" disease, the deficiency being the absence of the internal secretion of these islet cells of the pancreas, in the same way that myxodema is due to deficiency of the internal secretion of the cells of the thyroid gland Various attempts were made to treat diabetes by the oral administration of pancreatic extracts, but without success Until 1922 all attempts to isolate the active principle of the internal secretion were also unsuccessful In that year Dr Banting and his co workers, while not succeeding in isolating the active principle, were able to produce a preparation which con

tained the active principle in a moderately pure state. This preparation is called insulin. The method of administration is by subcutaneous injection After a preliminary trial on animals it was used on human diabetics with strikingly beneficial results Glycosuria was lessened or abolished, blood sugar was lowered and there was wonderful clinical improvement These results have been amply confirmed by physicians in all parts of the world, and there is no doubt that a new era has begun in the treatment of diabetes The treatment is still in the experimental stage The amount required, the best spacing of doses, the regulation of the diet during treatment and many other points are still unsettled Much of the recent literature is more calculated to confuse than enlighten the ordinary practitioner

First and foremost, one must impress on the patient the fact that treatment with insulin involves dietary restrictions and that these restrictions, while not nearly so severe as in the pre insulin days, must be carried out conscientiously and accurately Owing largely to the somewhat misleading accounts which have appeared in the lay press, many people imagine that a few doses of insulin will not only cure diabetes, but will allow them to have a practically unrestricted diet It is only fair that the limitations of the treatment should be explained to patients, and that they should be told quite firmly that if they are not prepared to follow directions implicitly that it is useless to start on the treatment

It should also be explained to them that, so far as our present knowledge goes, insulin is not really a cure for diabetes, but that the daily use of it, combined with dietary restrictions, will *enable them to keep the disease in abeyance*

The next question to decide is whether the *patient must remain in bed for a time at the* beginning of the treatment Most of the authorities say that it is essential, and undoubtedly it is the ideal plan, but what *the ordinary practitioner* wants to know in the treatment of this disease is not what are the ideal conditions, but what are the minimum conditions necessary to allow the patient to have the advantage of the new treatment

Where the patient's circumstances are easy, and no great hardship is involved by a stay of three *to four weeks at home or in hospital, it is better* that he should do so Again, if the patient has marked denutrition, or much acidosis, he should certainly be in bed

In a mild or moderate case, however, where it is very difficult for a patient to lie up, and where his occupation is not very arduous, I see no reason why he should not have treatment while following his usual occupation

One advantage claimed for having the patient in bed is that there is more control over his diet While, to a *certain* extent, this is true, my experience shows that an intelligent and strong minded patient will follow the prescribed diet whether he is out of sight or not, but nothing

short of solitary confinement will keep a stupid or weak willed patient on the right road

Before describing the scheme which I recommend for the treatment of cases in general practice, I shall shortly describe the usual orthodox treatment of a case of medium severity in hospital under ideal conditions

The patient is kept strictly in bed The amount of sugar in a twenty four hours specimen of urine, while on ordinary diet, is ascertained and also whether acetone or diacetic acid is present The amount of blood sugar four to five hours after a meal is estimated The bowels are well opened and he is fasted for one day From his height and weight the surface area of his body is found by means of a table, and from another table, with age and sex taken into consideration is estimated the total food calories required for the basal maintenance diet The next step is to work out the proper constitution of a diet which will produce the required number of calories In doing so the first step is to fix the amount of protein which is given by various authorities, at different amounts ranging from ⅔ gram to 1 gram for each kilogram of body weight The next step is to calculate the amount of carbohydrate and fat, which with the aid of the protein will produce the required number of calories At the same time the carbohydrate and potential carbohydrate contained in the protein must be in proper proportion to the fat Different authorities give various complicated and greatly

divergent formulæ for working out the correct proportions Having selected one of these many formulæ, you proceed to work out the exact amounts of carbohydrate, protein and fat, and this diet is called the "basal maintenance diet It is supposed to be exactly sufficient to maintain the patient while at rest in bed and at the same time to prevent acidosis

Following the fast day, he is given this basal *maintenance diet If after three days there is* still glycosuria another fast day is given, followed by a half ration day In a mild case there should then be no sugar or acetone in the urine, and the carbohydrate is gradually increased, leaving the protein and fat constant, until there is just a constant trace of sugar in the urine The total sugar value of the diet at this stage, estimated by adding together all the carbohydrate, 58 per cent of the protein and 10 per cent of the fat,

ance is
sirable
which
can be obtained with each unit of insulin is
estimated
tolerance
the toleran
raised to 140 gm, provided the proper relationship of carbohydrate, protein and fat were maintained *If all goes well, the diet and insulin remain* constant The tolerance, however, may increase or diminish, if the former, either the carbohydrate

is increased or the insulin diminished, if the latter, the insulin is *increased* or the carbohydrate diminished

Such is a short sketch of the usual treatment with insulin as carried out in hospital, where the patient is under constant observation and all facilities are ready to hand It is a satisfactory method and is undoubtedly very scientific, perhaps ultra scientific, as the working out of elaborate tables and calculation to decimal points is scarcely justified by our very imperfect knowledge of the variations of the metabolic processes of the human body While fully approving of the use of these methods in hospitals, for it is by such means that further knowledge is gained, I am convinced that in the ordinary case one can obtain equally good results with much more simple methods, and that these methods are available in general practice and without special institutions

After all there are many fallacies in the data used in these highly scientific methods For instance, it is certain that the usual statement that each unit of insulin will allow a patient to utilise an extra 2 gm of carbohydrate is inaccurate It may occasionally do more, but in the great majority of cases it will do less The calculation of the extra carbohydrate which a patient can use on a given dose of insulin is consequently vitiated For instance I had a patient who, with 50 units of insulin daily could only metabolise a diet containing 80 grams of total sugar value If we accept the rule that *one* unit of insul-

always metabolise two grams of carbohydrate, it would appear that this patient's pancreas was actually a minus quantity!

Take again the proportion of carbohydrate to fat, the authorities differ very widely and they cannot all be right. As a *matter of fact practical* experience shows that there can be no invariable rule A ratio which prevents acidosis in one case may fail to do so in another

Again, even if the basal maintenance diet can be estimated accurately from the various factors, of height, weight, age and sex, it is certain that there is no constant relationship between this basal maintenance diet and the adequate diet, *that is the diet necessary to enable the patient to* carry on a fairly normal life, which is the diet we wish to ascertain If with or without the aid of insulin, he cannot utilise an adequate diet, we must certainly fall back on a lower standard which is within his powers, but this means a life of semi invalidism Some writers appear to regard an adequate diet as a "luxury' diet, but surely our object is to restore the patient to a fair degree of health and strength Merely keeping him alive, though better than letting him die, is very far removed from a successful result

In all new discoveries it seems difficult to rid our minds of preconceived ideas Just as our ancestors in the early days of the railway train continued to carry their luggage outside on the roof of the railway carriage, because they had been accustomed to do so when travelling by

stage coach, so we are inclined to adhere to many ideas of dietetic treatment which the discovery of insulin has rendered obsolete

Looking at the problem from a common sense point of view, it is a fairly simple one. Here is a patient with diabetes He is not utilising or storing sugar normally, and his metabolism for other food stuffs, especially fat, is also disordered. We know that his disability is due to impairment of the pancreatic cells, with consequent diminution of the natural supply of insulin, but we do not know whether this impairment is functional or organic, or whether the supply of insulin is absolutely or only relatively deficient. It may be that the diet has been unsuitable in quantity or quality, and that the supply of insulin, while unable to meet these excessive demands, is sufficient to metabolise an adequate and properly balanced diet This we can determine only by experiment, and the simplest means of doing so is to put the patient on an adequate diet, keeping the carbohydrate as low as is compatible with safety If he is able to utilise this diet, that is if glycosuria ceases, the blood sugar is normal, there is no acidosis, and he maintains proper weight and strength good and well. If not he must be given enough insulin daily to enable him to do so The quantity of insulin necessary is found by giving gradually increasing amounts while the diet is kept constant.

CHAPTER VII

Scheme of Treatment for a Case of Moderate Severity where there is neither much Denutrition or Acidodsis

Section I By Standard Diet Alone

If his work is not very arduous, he can go about his usual occupation The case is investigated as described in the previous chapters A careful history should be taken of the date of onset, the order of appearance of symptoms, such as [illegible] etc Pr[illegible] illnesses P[illegible]rsonal

[illegible] to alcohol, etc *Family history*, whether any cases of diabetes A 24 hour specimen of the urine is obtained while on usual diet The amount of sugar is estimated, and acetone and diacetic acid tested for The specific gravity is of comparatively little importance, though a specific gravity relatively low to the amount of sugar found is suggestive of a low urea content and would suggest a searching examination into the efficiency of the kidneys A systematic search for septic foci should be made, special attention being directed to the state of the teeth and gums If any dental treatment is required

it should be carried out at once All the other systems should be thoroughly investigated and results noted The slightest cough necessitates a painstaking and minute examination of the chest and the microscopic examination of any sputum

Blood sugar The most frequent question asked me by practitioners is whether an estimate of the blood sugar is essential before commencing insulin treatment In all cases it is very desirable, but it may be omitted when there are marked clinical signs of true diabetes especially where there is acetone or diacetic acid in the urine This precaution would generally serve to prevent the use of insulin in renal glycosuria or other conditions where its employment would be dangerous or useless Wherever circumstances permit, however, the amount of blood sugar four to five hours after the last meal should be ascertained In the great majority of cases this is sufficient, but if the result is equivocal a sugar tolerance test should be done If the practitioner does not do the test himself he can draw off a few cc's of blood from a vein into a tube containing a little potassium oxalate, adding one drop of 40 per cent formalin as a preservative (Graham), and send without delay either to a physician or to a laboratory

From a consideration of his previous weight and from one of the ordinary tables of average weight for height, an idea can be formed whether the patient's weight is a fair one or whether an increase or a decrease would be desirable

The next step is to prescribe a diet which will be adequate without being excessive For reasons given in a previo I do not think that in practice there is relationship between the weight of t the caloric value of necessary food of a large number of for most adult patients a " tc produce about 2,300 one to begin on This diet has d something on the lines in a simplified form

First fix the amount of of protein necessary for an a matter of dispute As constituent of the diet, and repair cannot be carried on, on the side of giving too and this applies with special people where growth as well as provided for For the same can do with less and it is al give any considerable excess renal inefficiency To do so w unnecessary strain on the there is often a tendency to renal inefficiency

Another consideration has to be namely, that it is impossible acceptable diet from ordinary f protein factor is very low

Hutchison, in his fascinating bo-

after reviewing the whole subject, thinks that an average man doing moderate work requires from 100 to 120 gms protein per day and that at the least he should have 80 gms of which a considerable portion should be animal protein. Probably a fair working rule is to allow 2 gms per kilo of body weight for young patients, 1 gm per kilo for elderly patients and 1½ gms per kilo for those of middle age. Still more simply, one is not far wrong in allowing about 80 gms protein daily for the average adult leading an ordinary life.

Having fixed the amount of protein we must now work out the amount of carbohydrate and fat which, along with the protein, will give a diet of 2,300 calories. Two things must be borne in mind, first, that each gramme of carbohydrate or protein produces 4 calories and that each gramme of fat produces 9 calories, and secondly, that the amount of fat should not be in too great excess. The reason, as explained before, is that a certain proportion of carbohydrate is necessary for the proper metabolism of fat and the prevention of acidosis. A good working rule for the right proportion is that given by Woodyatt, viz. that the fat should not exceed twice the total carbohydrate plus half the protein.

For example, if the amount of protein is fixed at 80 grams, the maximum amount of fat allowed would be 186 grams, while the carbohydrate would be 73 grams if we wish to have a diet of about 2,300 calories.

Saccharine, to the extent of a few tablets a day, appears to do no harm, but it is more desirable that the patient should lose the taste for sweet things, which he speedily does. For a special occasion jellies may be given if made of gelatine, flavoured with orange or lemon juice and slightly sweetened with saccharine.

rather expensive, owing to the quantity of agar-agar required. This can be greatly reduced if the white of one egg is added.

Recipe for Bran Biscuits.

Bran (the variety used for feeding cattle)	2 ozs
Agar agar, powdered.	¼ oz
One white of egg.	
Pinch of salt	
Cold water.	8¼ ozs.

The bran is tied in cheese cloth and hung under the cold water tap to wash. It is squeezed repeatedly until the water runs through clear, which takes about half an hour. The agar is mixed in 3½ ozs. cold water and brought to the boil. The white of egg is slightly beaten up and mixed with the bran. The hot agar solution is next added, and *the mixture is moulded into eight thin* biscuits. When firm and cold, these are baked until dry and crisp.

If only two or three biscuits are allowed in the day, *the quantity of both carbohydrate* and *protein* is negligible.

No patent food of any kind should be used unless the makers furnish a certified analysis of the amount of the carbohydrate, protein and fat that it contains.

In framing a diet, several things have to be borne in mind. While there is no very great alteration in the amount of protein from that contained in an ordinary diet, the whole relationship of carbohydrate to fat is altered In an ordinary diet there is roughly six times as much carbohydrate as fat, while in a diabetic diet there may be three times as much fat as carbohydrate. This is a very great difference, and in anything but a mild case with little or no acidosis it is a good plan to make the change a gradual one The easiest way to do this is to prescribe the diet on the lines given above, but instruct the patient to begin with a daily allowance of 3 to 4 extra ozs of bread, and reduce this by 1 oz. or more a day until the prescribed amount is reached.
[illegible]

Patients miss the bulk of diet they are accustomed to, hence the necessity of always [illegible]

repletion.

There is often difficulty in getting the requisite amount of fat presented in an appetising form. In these cases one must ring the changes between

Saccharine, to the extent of a few tablets a day, appears to do no harm, but it is more desirable that the patient should lose the taste for sweet things, which he speedily does For a special occasion jellies may be given if made of gelatine, flavoured with orange or lemon juice and slightly sweetened with saccharine

[illegible] the place [illegible] these are [illegible] they are rather expensive, owing to the quantity of agar agar required This can be greatly reduced if the white of one egg is added

Recipe for Bran Biscuits

Bran (the variety used for feeding cattle)	2 ozs
Agar agar powdered	¼ oz
One white of egg	
Pinch of salt	
Cold water	*8¼ ozs*

The bran is tied in cheese cloth and hung under the cold water tap to wash It is squeezed repeatedly until the water runs through clear, which takes about half an hour The agar is mixed in 3½ ozs cold water and brought to the boil The white of egg is slightly beaten up and mixed with the bran The hot agar solution is next added, and the mixture is moulded into eight thin biscuits When firm and cold, these are baked until dry and crisp

If only two or three biscuits are allowed in the day, the quantity of both carbohydrate and protein is negligible

No patent food of any kind should be used unless the makers furnish a certified analysis of the amount of the carbohydrate, protein and fat that it contains

In framing a diet, several things have to be borne in mind While there is no very great

diet there is roughly six times as much carbohydrate as fat, while in a diabetic diet there
arbohydrate
in anything
cidosis it is a
good plan to make the change a gradual one The easiest way to do this is to prescribe the diet on the lines given above, but instruct the patient to begin with a daily allowance of 3 to 4 extra ozs of bread, and reduce this by 1 oz or more a day until the prescribed amount is reached

At the same time he begins with about half the amount of fat prescribed in the diet, and increases this daily till the full allowance is reached

Patients miss the bulk of diet they are accustomed to, hence the necessity of always making green vegetables an important item in the diet list They contain very little carbohydrate, but from their bulk give an agreeable feeling of repletion

There is often difficulty in getting the requisite amount of fat presented in an appetising form In these cases *one must ring the changes* between

bacon, butter, cream, etc, and serve them up in as many different ways as possible If olive oil or sardines can be taken, they are a great stand by Walnuts are useful, but somewhat indigestible One cannot emphasise too much the necessity of having the food cooked and served as nicely as possible, and with as great a variety It makes all the difference to a healthy person, and much more to a patient who is chafing against all the restrictions of his diet

All the weights given in the above table are *those of the cooked article* The reason for this is that where a patient is a member of a household, it is often impossible for him to have his ration *cooked separately There may be a family* joint, or in the case of porridge it would be very difficult to make, say, four ounces of porridge by *itself Again in the case of fish, there is so much* waste material in small fish that the weight in a raw state is little guide to what is actually consumed How then should the food be weighed without interfering with tasteful service? A small scale, like a large letter scale, should be obtained and kept on the table It is a convenience to use a similar plate for weighing everything, and to have a disc of lead to act as an exact counterpoise on the other side of the scale For weighing hot food the disc to balance the plate, plus the requisite weights, are placed on one side of the scale and a hot pl[illegible] d o[illegible] other Porridge, or whatever is quickly put on the plate

and served immediately Similarly for hot liquids the same cup or bowl of known capacity can be used, instead of having to transfer each time to a measure and back again

A daily diet list of about 2,300 Calories may be made up as follows —

	Carbohydrate (grams)	Protein (grams)	Fat (grams)
3 eggs	—	18	18
3 ozs butter	—	—	72
10 ozs vegetables (5 per cent)	10	2 5	—
8 oz meat	—	21	15
2 ozs ham	—	12	16
2 ozs bacon	—	6	30
5 ozs milk	6	5	5
1 oz oatmeal	18	4	2
1½ ozs potato	9	1 5	—
2 ozs brown bread	26	3	1
½ oz olive oil	—	—	15
1 oz cheese	1	8	9
	70	81	183

If the patient is not very intelligent, or has no knowledge of cooking and the arrangement of meals, it is desirable to give him, in addition to the daily ration list, a few specimen menus of the different meals of the day The following menus will illustrate the way this can be done with the 2,300 Calories "standard" daily ration When the patient is well off it is easy to get very considerable variety, but it is by no means so easy when means are limited It is obvious that a diabetic diet is an expensive diet, especially in winter, when green vegetables and eggs are scarce and dear There are physiological reasons

why, in an ordinary diet, carbohydrate should largely predominate over fat, but there is the economic reason also, viz , carbohydrates are much cheaper than fats The reversal of this proportion in the diet of a diabetic means a great increase in cost

INEXPENSIVE MENU FOR ONE DAY

Breakfast

4 oz porridge (1 oz oatmeal)
2 oz milk
Tea and ½ oz milk.
1 egg
2 oz bacon
1 oz brown bread
½ oz butter

Dinner

1 cup beef tea
3 oz meat (beef or mutton)
5 oz cabbage cooked with 1 oz butter
1½ oz potato
1 bran biscuit
½ oz butter
1 oz cheese

Tea

Tea with ½ oz milk
1 oz brown bread
½ oz. butter
2 oz lettuce, tomato or cucumber

Supper

Coffee with 2 oz hot milk
2 boiled eggs
2 oz cold ham
3 oz salad with ½ oz olive oil
1 bran biscuit.
½ oz butter

Inexpensive Menu for Workmen and Others who have to take their Lunch out with them

Breakfast

4 oz porridge (1 oz oatmeal)
1¼ oz milk
Tea with ½ oz milk
2 oz herrings fried with ½ oz butter
1 oz brown bread
½ oz butter

Lunch

Hot coffee in thermos flask, made with
2 oz milk
1 oz brown bread
1 oz butter
1 oz cheese
2 hard boiled eggs (or 2 oz tinned salmon or sardines)
2 oz cold ham
3 oz salad
¼ oz olive oil

Dinner

1 cup beef tea
2 oz tripe browned in ¼ oz butter and stewed slowly
2 oz onions fried in ½ oz dripping
4 oz greens
1¼ oz potato mashed with ½ oz milk.
1 poached egg

Supper

Cup of tea with ½ oz milk
2 bran biscuits
½ oz butter

MORE EXPENSIVE MENU (1)

Breakfast

8 oz grape fruit
Coffee made with 2 oz milk
2 oz bacon with 2 oz tomato, grilled
1 boiled egg
1 oz brown bread
½ oz butter

Lunch

1 cup beef tea
2 stuffed eggs (hard boiled eggs cut in half, pound the yolks with 1 oz butter, and a flavouring of anchovy) Serve cold with 3 oz salad
2 oz cold ham
1 bran biscuit
½ oz butter

Tea

Tea with ½ oz cream (thin)
1 oz brown bread
½ oz butter
2 oz banana

Dinner

2 oz salmon with 1 oz cucumber
2 oz beef steak grilled with 2 oz onion
1 oz potato
5 oz French beans or stewed celery
3 oz walnuts
Coffee with ½ oz milk

MORE EXPENSIVE MENU (2)

Breakfast

2 oz grape fruit
Coffee with 2 oz milk
1 egg
2 oz bacon
1 oz brown bread
½ oz butter

Lunch

1 cup beef tea
2 oz cold ham
3 oz salad with ½ oz olive oil
2 bran biscuits
½ oz butter
½ oz cheese
3 oz banana

Tea

Tea with ½ oz milk
1 oz brown bread
½ oz butter

Dinner

2 oz fish (white), 2 oz cucumber or tomato
2 oz meat (beef or mutton)
5 oz leeks or cabbage, boiled and flavoured with bovril
Savoury omelette made with 2
1 oz butter and ½ oz
cheese, pepper and salt to taste
2 oz walnuts
Coffee made with 2 oz milk

MORE EXPENSIVE MENU (3)

Breakfast

Tea with ½ oz milk
1 oz brown bread
½ oz butter
1 egg scrambled with ½ oz milk
½ oz butter
2 oz grilled bacon

Lunch

3 raw oysters
2 oz cold ham with 4 oz
grilled with 4 oz tomato.
1 bran biscuit
½ oz butter
1 oz cheese

can be carried out sufficiently to stop the loss in weight and restore a fair amount of energy without this symptom appearing, all is well If not, the amount of carbohydrate may be cautiously increased, and the same good result obtained, but if the addition of carbohydrate gives rise to glycosuria, the attempt must be abandoned and insulin treatment begun

When there is no glycosuria, an occasional blood examination is desirable to make certain that the blood sugar is keeping within normal limits The leak point of the kidneys in some cases may be so high that although there is no glycosuria, the blood sugar may be considerably above the normal level

General directions are given, the details of which must depend on the circumstances of the patient. The bowels should be kept well open, and for this purpose an early morning draught of a mild saline, such as Carlsbad salts in a tumblerful of hot water, is useful Water or soda water should be taken freely between meals Warm clothing should be worn Ladies' fashions at the present time apparently make it difficult for them to wear adequate under garments There is not much difficulty with men, but, avoidance of worry and adequate rest are very important Even if a patient is following his usual occupation, he should rest as much as possible in his spare time and go to bed early It is useless to spend time arranging a diet calculated to produce enough heat and energy

The increase may be made every day or every second day at first, but at longer intervals as the larger doses are reached Any case which requires more than 40 units a day should be in a nursing home or hospital till the correct dose is found, as constant supervision should be available during this period

Control of Dosage

This is a most important question If constant blood sugar estimations are essential, the treatment must be largely confined to physicians working in special institutions, while if dosage can be controlled by urinary examination the treatment can be carried out by the general practitioner in his ordinary practice In the majority of cases the urinary examination is quite sufficient, and if the practitioner is prepared to study the elementary principles of dietetics and is able to devote a little time and thought to his cases, there is no reason whatever why he should not employ insulin in his diabetic cases

The ideal aim of treatment is to keep the blood sugar constantly within normal limits, and the only danger in attempting to do so is that the blood sugar may at some period of the day be so much reduced below these limits as to cause a hypoglycæmic reaction One would imagine that as the danger arises from lowered blood sugar that frequent blood examinations would obviate the risks No doubt it is the best method, but even daily examinations,

and this is scarcely practicable, do not entirely do so

Some months ago I had a patient under treatment in hospital who was getting on well with moderate doses of insulin One afternoon he had a definite hypoglycæmic reaction although his blood sugar, which happened to have been estimated that morning had been 155 mgr and he

risk of hypoglycæmia In the vast majority of cases however so long as there is a trace of

each day, and that this is undesirable as it involves overwork of the pancreatic cells that, as the urine should be kept quite sugar free the only method of controlling dosage is frequent blood sugar estimations This objection may be true in theory, but practically control by urinary examination alone works very well and, if the dosage of insulin is only gradually increased, is

possible, and even dangerous, to give vaccines without opsonic control that to do so was to invite disaster from a negative phase Now

vaccines are given freely by all practitioners, and I imagine that the estimation of an opsonic index is a rare event

In both cases the examination of the blood was essential in the initial experiments, but can be more or less dispensed with as experience is gained

At the beginning of treatment, both an evening (1 hour after supper) and a morning (before breakfast) specimen of urine should be examined daily These are convenient times for a patient to get specimens, and both can be brought to the doctor in the morning What one expects to find depends on whether the patient is a mild case who is having only a single morning dose of insulin, or whether he is a more severe case who is having two doses, one in the morning and one before tea In the former, who has fair sugar tolerance, the effect of the morning dose of insulin lasts all day, but is becoming exhausted by the evening, with the result that he has no glycosuria during the day but a trace appears after supper The night's fast abolishes this again, so that the morning specimen is sugar-free In the latter, where the tolerance is not so good, the effect of the morning dose is passing off by the afternoon, but the second dose reinforces the effect. There is no glycosuria till early the next morning

The dose of insulin should be increased until there is just the *faintest trace* of sugar in *either* of the specimens After the treatment is estab-lished, an intelligent patient can regulate the d

himself and safely keep his urine entirely sugar free The examination of the urine shows him if he is having too little insulin, and his own
h
acetone
s only a
small quantity of the former and none of the latter, no anxiety need be felt and no change indicated If, however, there is much acetone (as shown by the nitro prusside test giving a distinct colour within half a minute), or if the ferri perchlor test is definitely positive, the fat in the diet is diminished and the carbohydrate increased

When the necessary dose of insulin has been ascertained and the proportions of carbohydrate and fat adjusted, the further regulation of the diet, if any is required, is made on the lines described previously, where the patient has been rendered sugar and acetone free without the use of insulin In the unlikely event of the diet of 2,300 calor

cient as shown b

if it does, the carbohydrate must be increased and the dosage of insulin also increased if necessary

After the initial stages of treatment, patients of average intelligence may usually be trusted to examine their own urine. This is not only a great saving of time to the doctor, but impresses on patients the necessity of adhering to the prescribed diet. I have always found that patients who test their own urines are the most satisfactory ones. The evil of any surreptitious addition to the diet is forcibly brought home to them and they do not offend again. All they require is a spirit lamp, some Fehling's solution, some dilute liq. ferri perchlor. and some test tubes. There is a practical point with regard to the latter. See that they are provided with small test tubes, about ½ inch, instead of the usual large ones. This allows a great saving of Fehling's solution, which is quite a consideration *to people of* moderate means, when frequent examinations are being done. They should enter the results in a book daily, which is shown to the doctor when they report themselves.

Who is to administer the insulin? In the vast majority of cases it is impossible for the doctor to do so. The exigencies of his work make it out of the question to see a patient twice, or even once daily at a specified time, and that usually an inconvenient one. Even if he could do so, the cost to the patient would be prohibitive. Sometimes it is possible to arrange that a nurse should give the injections, and district nurses have been kind enough to do it for some of my hospital patients when they left the institution. Usually

the patient has got to learn to inject himself, and, as a rule, there is no difficulty in teaching him how to do it antiseptically One has to

He is

with

some

tincture of iodine, a little lysol, and some cotton wool A small quantity of ether is poured into a clean egg cup After taking the wire out of the needle, it is put on to the syringe, which is filled and emptied of ether several times, taking care that the needle is quite submerged in the ether The piston is worked up and down several times to get rid of all the ether After putting a drop of lysol on the rubber stopper of the insulin bottle, the needle is inserted, and the requisite amount of insulin drawn up into the syringe The area selected for the injection is then rubbed with a small piece of cotton wool soaked in the

with ether, dried again, and the wire inserted in the needle The reason for advising a minim syringe, instead of one graduated in c cs, is that

minims better

cs into minims

9 m, practically

one can call it 10 m Then, if you wish the patient to have 10 units, the dose is 0 5 c c or 8 m The site of injection is immaterial For patients who are injecting themselves, the upper

part of the chest in men and the outer side of the thigh in women are sometimes found more convenient than the arm At first I was very doubtful of allowing patients to inject themselves in case they would get septic arms, but, after six months experience of about forty patients injecting themselves once or twice daily, there has not been the slightest trouble Occasionally, after injection, there is said to be some redness and swelling due to protein reaction, but I have not seen it

Expense In spite of the recent reduction, the price of insulin is very high The 5 c c bottle containing 100 units, costs 12s 6d, which works out at about 1½d per unit Employed men and women are all right, as insured persons are entitled to have insulin supplied free under the National Health Insurance Act Incidentally, all panel practitioners should know that the cost of this and similar preparations is kept in a [illegible] *of being*

The case

or very

moderate means, or the wives of working men, is very different While the cost of a small daily dose, such as 10 units (1s 3d), may be managed, it is impossible for them to afford, say 30 units, costing 3s 9d per day, especially as the necessary diet is more expensive than an ordinary one The Swansea hospital authorities are generously supplying with insulin, on leaving the hospital, all in patients not being insured persons, who are

certified by the physician in charge as being suitable cases, provided they report themselves at the hospital at prescribed times (usually every two weeks), so that blood or other examinations can can be made as required. The preliminary stay in hospital weeds out patients who are not prepared to submit to dietary restrictions, and those who have not sufficient intelligence to carry on the treatment outside. This still leaves untouched the problem of the middle class patient, and I

CHAPTER VIII

HYPOGLYCÆMIA

THE normal fasting blood sugar, as we have seen in a previous chapter, is from 80 to 120 mgr per 100 c c The essential action of insulin is to lower the blood sugar, and, if by excessive dose or by the administration of an ordinary dose not followed by a meal, the blood sugar is unduly lowered, a condition of hypoglycæmia results Nothing much happens until the blood sugar is reduced to about 60 mgr At this point a train of symptoms appear, to which has been given the name of hypoglycæmic reaction The time of occurrence is variable If the insulin has not been followed by food, the reaction may appear in half an hour, if it has been followed by food, the reaction may not appear till some hours later

ness of vision, tremor, and nearly always profuse perspiration If no treatment is given, spontaneous recovery may take place, or the patient may pass into a state of coma and death Fortunately, prompt recovery takes place, when 10 to 20 grammes (½ oz) of glucose is given by the mouth

If this is not available, a few ounces of orange juice, ordinary cane sugar, or even milk does well For slight symptoms, a cup of tea with two or three lumps of sugar does very well If coma has developed so far that swallowing is impossibe, about 200 c c of a 5 per cent solution of glucose should be given subcutaneously or intravenously A similar solution may be given rectally, while the apparatus for subcutaneous or intravenous injection is being prepared, and may be effective In a comatose case, 1 c c of 1 in 1000 solution of adrenalin should be given intramuscularly Adrenalin causes any reserve of glycogen in the liver to pass into the blood as sugar Even if it is effective in rousing the patient, sugar should be given as soon as possible

All patients should be warned of the danger of

that they know what to look out

The actual cause of the
is probably the inability of the obtai
normal supply of sugar l,
blood sugar is reduced

In the early days of
alarming experiences of
as shown in the fol'

case, inasmuch as the patient experienced both diabetic coma, and later on hypoglycæmic re action

Case 6 —A woman, aged 38, with two years history of diabetes Has lost 5 stones in weight Double diabetic cataract causing total blindness Looks wretchedly ill depressed and emaciated Passing 82 gms sugar daily Acetone and diacetic acid Her case is described fully in connection with diabetic coma

She was on 30 units of insulin daily without much effect on the urine and blood sugar, when the dose was increased to 60 units in three doses of 20 units each At the end of the first day she was sugar and acetone free The same treatment was continued the following day, but about 9 p m she became rather drowsy, and at 10 p m became almost completely comatose, and was sweating profusely Urine drawn off by catheter con tained no sugar, acetone or diacetic acid The blood sugar was 60 mgr Fifty grms of glucose were given with great difficulty by the mouth, and in 15 minutes the patient had completely recovered.

This alarming experience should have been avoided first by increasing the dose of insulin more slowly, and secondly by lessening the dose on the second day, when the urine was sugar free, or by examining the blood to ascertain how far the sugar content had [illegible]

Another case is of interest, as s[illegible] a very small dose of insulin m[illegible] glycæmia [illegible]

Case [illegible] aged 64 three [illegible] diabetes [illegible] 48 gms of the urin[illegible] trace of fasting [illegible] was not doing dietetic [illegible] was given 10 each day [illegible] The urinary to a trace, [illegible], about

breakfast, he got a definite though not severe hypoglycæmic reaction which was promptly relieved by the administration of sugar I do not see how even a blood sugar examination that morning could have avoided this reaction as there was a trace of sugar in the urine, and his leak point was not low

It can be readily understood that the greatest danger from hypoglycæmia would occur when the reaction took place at night A patient might pass from ordinary sleep to a state of coma and death, so that there would be no opportunity of treatment I do not know that any such catastrophe has actually happened, but the possibility emphasises the necessity of never giving insulin near bed time

Again, the danger of a reaction is much greater during the first few weeks of treatment than at a later date The reason for this is, that in the early stages there may be very little reserve of glycogen in the liver and muscles for the blood to draw on, as its own sugar content falls, whereas later on a reserve has been built up Out of some forty hospital cases, who since discharge [illegible]

forgot all about his tea until reminded of it by the onset of hypoglycæmic symptoms As he had already had one reaction while in hospital, he recognised the symptoms at once, swallowed

20 grams of fat and will produce about 1,200 calories The patient being in bed these calories are sufficient

Insulin should be given in doses of from 10 to 40 units daily, the actual amount depending on blood sugar and the effect on the urine It must be constantly remembered that what we are treating now is acidosis, i e, we want to get rid of the diacetic acid in the urine The amount of sugar which is being excreted does not at the moment trouble us There is no need to give too much carbohydrate, but so long as there is diacetic acid, our aim is to have at least a good trace of sugar present in the urine, so that we are certain of having enough sugar in the system for the insulin to work on, and so permit the proper metabolism of fat In short the insulin is pushed until the urine is acetone and diacetic acid free, while enough carbohydrate is given to keep the blood sugar above normal This can be ascertained either by blood sugar examination or more simply by keeping a constant trace of sugar in the urine

This insulin treatment of acidosis is wonderfully successful When cases are got at this stage I have never seen it fail to bring about striking and rapid improvement When the acidosis has been cleared up, the diet is gradually readjusted and treatment of the underlying diabetic condition instituted

CHAPTER X

Impending Coma and Coma.

1 Ordinary Type of Coma Associated with Acidosis

There is no hard and fast line between this and the last group of cases. There is often a gradual progression from acidosis to impending coma and complete coma Occasionally, however, the onset of coma is quite sudden. The patient without previous warning, and perhaps without any knowledge that he is suffering from any disease, is suddenly attacked with weakness,

[illegible]

constant attention and to have skilled nursing assistance As, however, there is often no opportunity to get the patient removed without the loss of valuable time it is very necessary that all practitioners should be familiar with the symptoms of the condition and the best line of treatment

Symptoms

The first warning symptom is often anorexia with gastric discomfort or pain, followed by

20 grams of fat and will produce about 1,200 calories. The patient being in bed these calories are sufficient.

Insulin should be given in doses of from 10 to 40 ... blood ... ust be constantly remembered that what we are treating now is acidosis, *i.e.*, we want to get rid of the diacetic acid in the urine. The amount of sugar which is being excreted does not at the moment *trouble us. There is no need to give too much* carbohydrate, but so long as there is diacetic acid, our aim is to have at least a good trace of sugar present in the urine, so that we are certain of having enough sugar in the system for the *insulin to work on, and so permit* the proper metabolism of fat. In short the insulin is pushed until the urine is acetone and diacetic acid free, while enough carbohydrate is given to keep the blood sugar above normal. This can be ascertained either by blood sugar examination or more simply by keeping a constant trace of sugar in the urine. ... is wonderfully

rapid improvemer
cleared up, the
treatment of the
instituted.

CHAPTER X

IMPENDING COMA AND COMA

1 ORDINARY TYPE OF COMA ASSOCIATED WITH ACIDOSIS

THERE is no hard and fast line between this and the last group of cases There is often a gradual progression from acidosis to impending coma and complete coma Occasionally, however, the onset of coma is quite sudden The patient without previous warning, and perhaps without any knowledge that he is suffering from any disease, is suddenly attacked with weakness, headache, syncope, and gradually deepen

the practitioner is able to give them close and constant attention and to have skilled nursing assistance As, however, there is often no opportunity to get the patient removed without the loss of valuable time it is very necessary that all practitioners should be familiar with the symptoms of the condition and the best line of treatment

Symptoms

The first warning symptom is often anorexia with gastric discomfort or pain, followed by

20 grams of fat and will produce about 1,200 calories The patient being in bed these calories are sufficient

Insulin should be given in doses of from 10 to 40 units daily, the actual amount depending on blood sugar and the effect on the urine It must be constantly remembered that what we are treating now is acidosis, i e, we want to get rid of the diacetic acid in the urine The amount of sugar which is being excreted does not at the moment trouble us There is no need to give too much carbohydrate, but so long as there is diacetic acid, our aim is to have at least a good trace of sugar present in the urine, so that we are certain of having enough sugar in the system for the insulin to work on, and so permit the proper metabolism of fat In short the insulin is pushed until the urine is acetone and diacetic acid free, while enough carbohydrate is given to keep the blood sugar above normal This can be ascertained either by blood sugar examination or more simply [illegible] trace of sugar in the urine

treatment of the underlying diabetic condition instituted

CHAPTER X

Impending Coma and Coma

1 Ordinary Type of Coma Associated with Acidosis

There is no hard and fast line between this and the last group of cases There is often a gradual progression from acidosis to impending coma and complete coma Occasionally, however, the onset of coma is quite sudden The patient without previous warning, and perhaps without any knowledge that he is suffering from any disease, is suddenly attacked with weakness,

constant attention and to have skilled nursing assistance As, however, there is often no opportunity to get the patient removed without the loss of valuable time it is very necessary that all practitioners should be familiar with the symptoms of the condition and the best line of treatment

Symptoms

The first warning symptom is often anorexia with gastric discomfort or pain, followed by

20 grams of fat and will produce about 1,200 calories The patient being in bed these calories are sufficient

10

d

e

constantly remembered that what we are treating now is acidosis, *i e*, we want to get rid of the *diacetic acid in the urine* The *amount of sugar* which is being excreted does not at the moment trouble us There is no need to give too much carbohydrate, but so long as there is diacetic acid, our aim is to have at least a good trace of sugar present in the urine, so that we are certain of having enough sugar in the system for the insulin to work on, and so permit the proper metabolism of fat In short the insulin is pushed until the urine is acetone and diacetic acid free, ... on to keep the

by keeping a constant trace of sugar in the urine

This insulin treatment of acidosis is wonderfully successful When cases are got at this stage I ... and

d

treatment of the underlying diabetic condition instituted

glucose is available give 15 grams (½ oz) dissolved in hot water, if not, give the juice of a large sweet orange which contains about the same amount of glucose Failing these, give a cup of hot weak tea containing a tablespoonful of ordinary [illegible]

more sugar The dose of insulin will depend on whether there has been improvement in the clinical picture or in the urine If little or no improvement give another 15 to 20 units, while if there is decided improvement 5 to 10 may be sufficient The urine is examined again every two or three hours and a dose of insulin, followed by sugar, continued until the urine is free of diacetic acid It is difficult to say exactly how much sugar should be given, but the urine should never be allowed to become sugar free until the patient is well out of danger

During this time other measures are being employed The patient should have complete rest in bed with plenty of blankets and hot water bottles The bowels are cleared out with an enema He should be given hot water, weak tea or coffee, bovril (but not milk on account of the fat it contains) The administration of fluid must not be overdone, the usual allowance being one pint every three hours for an adult, and half this amount for a child If the pulse is unsatisfactory, digitalin or stropanthin should be given hypodermically Since the advent of insulin there

nausea and vomiting Sometimes the characteristic heavy sweetish odour of the breath, said to be due to acetone, is the first thing noticed Other symptoms are pain in the back and legs with muscular weakness, restlessness, headache and drowsiness, flushed cheeks, dry tongue, feeble pulse If unrelieved the drowsiness passes into complete coma, which is characterised by the abnormal type of breathing The respiration is slow and deep, the so called "air hunger of Kussmaul

Examination of the urine shows that it is full of acetone and diacetic acid with a larger or smaller quantity of sugar Contrary to what one might expect, the blood sugar is often not very high, perhaps round about 200 mgr

Diagnosis

In the later stages this is usually obvious If a case is seen for the first time in coma and the diagnosis is in doubt, draw off a specimen of the urine If sugar and acetone or diacetic acid is found, treat at once as diabetic coma

Treatment

This depends on whether it is a case of impending or of complete coma when the patient is unable to swallow *In either case the first thing to be done is to give an injection of 25 to 30 units of insulin*

(a) *Impending*

As soon as [illegible] n

injected, give [illegible] f

her left eye and gave her very good vision She is still in fair health, sugar and acetone free and with a nearly normal blood sugar. She is able to take a moderate diet, about 1,600 calories, but requires 50 to 60 units of insulin daily Her tolerance is apparently decreasing as at one time she could take a similar diet with 40 units daily.

CASE 9.—Man, aged 62 Has had diabetes for eight years, latterly cataract both eyes Looks weak and ill. Urine contains 95 grams sugar daily Acetone present in large quantity but no diacetic acid Fasting blood sugar 206 mgr Treatment by Graham's ladder diet was begun, but on the 7th day he developed severe acidosis. He was very drowsy and vomited, and had the charact-
istic breath. Gave similar ...
case, and ...
an a...
and ...
resul...

CA... ..., aged 25, admitted to hospital on 25th April, 1923 One year's history of diabetes with usual symptoms of polyuria, thirst, weakness and loss of weight (two stones) Looks very ill, drowsy, has œdema of ankles and septic spots all over body No knee jerks Passing 115 grams sugar daily with much acetone and diacetic acid. Fasting blood sugar 890 grams Ordinary treatment by alimentary rest etc, tried for a few days but he became worse The breath smelt strongly of acetone, there was much acetone and diacetic acid in urine, he was becoming very drowsy and slightly cyanosed. Similar treatment was given and the acidosis quickly vanished and he looked a different man. We got him up to a diet of 1,600 calories while remaining sugar and acetone free and with a fasting bloo...
100 to 120 mgr but to do this he ...
of insulin daily This case is of ...
he has been able to assimilate a ...
with 80 units daily although ...
work which shows ... t in

has been much discussion as to the advisability of giving sodium bicarbonate or other alkalis Some authorities say they help, while some affirm that they are actually harmful As I never saw any result from alkalis in cases of coma before the days of insulin, I think they are just as well omitted.

The treatment at this stage is usually successful I have had three cases who all recovered and did well afterwards The following one may be taken as typical

CASE 6 —Woman, aged 38, with two years history of diabetes Has lost 5 stones in weight and had double cataract, causing total blindness Looked wretchedly ill, depressed and emaciated Passing 82 grams sugar

strongly of acetone and she was very drowsy She was put on insulin, 10 units every two hours at first, and subsequently at longer intervals, 10 grams of glucose or 1 oz of bread with some sweet tea being given after each dose It was three days before the acetone had completely disappeared from the urine, but the patient's condition soon changed marvellously From being drowsy, dull and depressed, she became bright and cheerful Shortly after dietetic treatment on Graham's plan was tried but without success Her tolerance for carbohydrate appeared to be practically nil She was then put on insulin 10 units three times a day but, with a very moderate diet, still had much glycosuria acetonuria and a high blood sugar The insulin was raised to 20 units three times a day which cleared everything up, but caused a severe hypoglycæmic reaction which was described on page 92 The cataract was removed from

previously cleansed with ether and iodine, the reservoir raised to about 2 feet and the requisite amount run slowly in. If it does not run in well another place can be tried. If the patient is so ill that it is doubtful whether fluids will be absorbed from the subcutaneous tissues, the glucose solution of the same strength may be given intravenously and the insulin by the same route and at the same time. In three hours or earlier in the absence of improvement, the urine is drawn off, and if it contains acetone or diacetic acid a further 10 to 20 units is given followed by the same amount of sugar. This process is repeated about every three hours till the acidosis is controlled. The insulin must be pushed but never sufficiently pushed in relation to the sugar, as to render the urine sugar free. It will be readily understood that if this were allowed the blood sugar might drop to such an extent as to cause a hypoglycæmic reaction. It is no use saving a patient from diabetic coma to plunge him into the coma of hypoglycæmia. Blood sugar examination is a great help in controlling the amount of insulin and sugar required, but the periodic examination of the urine as detailed above is generally sufficient to avoid danger. It may seem unn ... armful, to administer gl ... lood sugar is already c ... ing into theoretica ... experien ... insulin

(b) *Complete Coma*

The initial indication is the same as in impending coma, but here it is advisable to give 30 units of insulin at once The difficulty is that the patient cannot take anything by the mouth so the necessary *sugar must be introduced per rectum* or by subcutaneous or intravenous injection If the lower bowel is empty a 300 c c (about half a pint) of a 5 per cent solution of glucose can be given slowly by this route If it is not retained, or if the appliances are ready to hand, it is better to proceed at once to give a subcutaneous injection In this case, the strength and quantity of the glucose solution is the same *but of course strict antiseptic precautions must* be taken The simplest plan is to use one of the glucose tubes supplied by the various drug houses The contents of one tube are diluted to one pint with boiled water which makes a sterile 5 per cent solution If one of these tubes is not to hand, though it is a very useful thing to keep for emergencies, a solution must be made up from pure glucose and boiled water, the pro*portions being 1 oz to a pint* An outfit such as is usually carried in a midwifery bag does very well or an ordinary aspirator needle attached to about three feet of rubber tubing with a suitable glass reservoir above The barrel of an all glass 10 or 20 c c syringe will do in an emergency The whole outfit is boiled and filled with the sterilised glucose solution *The needle is inserted* under the skin of the chest, the skin having been

previously cleansed with ether and iodine, the reservoir raised to about 2 feet and the requisite amount run slowly in If it does not run in well another place can be tried If the patient is so ill that it is doubtful whether fluids will be *absorbed from the subcutaneous tissues, the* glucose solution of the same strength may be given intravenously, and the insulin by the same route and at the same time In three hours or earlier in the absence of improvement, the urine is drawn off, and if it contains acetone or diacetic acid a further 10 to 20 units is given followed by the same amount of sugar This process is repeated about every three hours till the acidosis is controlled The insulin must be pushed but never sufficiently pushed in relation to the sugar, *as to render the urine sugar free* It will be readily understood that if this were allowed, the blood sugar might drop to such an extent as to cause a hypoglycæmic reaction It is no use saving a patient from diabetic coma to plunge him into the coma of hypoglycæmia Blood sugar examination is a great help in controlling the amount of insulin and sugar required, but the periodic examination of the urine as detailed above is generally sufficient to avoid danger It may seem unnecessary, and indeed harmful, to administer glucose to a patient whose blood sugar is already excessive but, without going into theoretical considerations it has been found by experience that coma patients do better with *insulin and sugar than with insulin alone*

Especially when blood sugar estimation is not available, it is much better to err on the side of giving too much sugar than giving too little

The same general directions apply as in the case of impending coma The patient is of course in bed and kept warm with blankets and hot water bottles Unless the initial dose of glucose is being given per rectum the bowel is emptied with a soap and water enema, and the heart is supported with digitalin, etc A certain amount of fluid is being given with the glucose, but a total amount of one pint every three hours should be aimed at in an adult This can be made up by rectal, subcutaneous or in extreme cases intravenous injections of normal saline In hospital continuous rectal administration by the thermos flask and drop method of either normal saline, or normal saline and glucose is of great value

Just before insulin became available I had three cases of diabetic coma all of whom died Since then, although I have had a good many cases of impending coma, I have had only one case of frank diabetic coma, and this case was admitted in a moribund condition

CASE 10—Girl aged 20 History of diabetes for some months She had gone into a state of coma sixteen hours before admission On admission she was wasted to almost literally skin and bone she was deeply unconscious, breath smelling of acetone and the urine drawn off with the catheter contained much sugar, acetone and diacetic acid Thirty units of insulin were given subcutaneously and glucose and saline given intravenously by the saphenous vein as it was impossible

to find the veins in the arm She never recovered consciousness and died shortly after admission

However, there are a good many cases on record of complete recovery after even complete coma of this type, so that hope should never be abandoned The keynote of treatment is immediate, large and repeated doses of insulin "buffered" as the Americans say, by adequate doses of glucose

2 Coma of the Post Operative Type

The second group of coma cases characterised by abundant glycosuria very high blood sugar but little or no acidosis are not nearly so amenable to treatment

Pathology

While the consensus of opinion is that ordinary diabetic coma with acidosis is caused by the toxic effect on the brain of the oxybutyric acid in the circulating blood, there does not appear to be any satisfactory explanation of the cause of the coma in the group of cases which we are now considering There is little or no acidosis and presumably there can be no great excess of oxybutyric acid in the circulating blood The mere excess of blood sugar cannot be the cause, as it may rise to the same height without causing any symptoms of coma Again it might be argued that although sugar is present in excess in the blood, the brain cells are no longer able to use it, and that coma really results from a deficiency of *available* sugar This seems unlikely as the

the left great toe was black, fairly dry, and with a fairly definite line of demarcation, but the dorsum of foot showed some lines of inflammation and was somewhat tender There was also a black bleb at inner surface of right great toe He was passing 172 grams of sugar daily and the urine contained a small quantity of acetone but no diacetic acid Blood sugar 398 mgr General condition fairly good (Urine slight trace of albumen) He was kept in bed, the toes kept dry and clean and given a diet containing 75 grams of carbohydrate and a total caloric value, with a daily allowance of 2 oz of alcohol, of 2,400 calories Insulin was given in gradually increasing quantity, but it was not until a dose of 80 units twice daily was reached that the urine became practically sugar free and the blood sugar became *reduced to 160 mgr The gangrene did not spread and* now five months after onset of gangrene, the right toe has healed up after the separation of a small slough while the left great toe sloughed off at the original line of demarcation and has almost healed.

CASE 16 —Man, aged 58 History of diabetes for eleven years Nine months previously had dry gangrene of little toe of right foot which sloughed off, and he recovered Kept pretty well till three weeks before I saw him, when he had got a small patch of gangrene below ball of right great toe, which was now moist and tending to spread along sole of foot Urine contained 4 5 per cent of sugar, acetone but no diacetic acid

but the gangrene continued to spread The leg was amputated above the knee but there was a large slough

The other case was gangrene of a toe following the opening of a small abscess He was feeling ill when admitted to hospital but was so much better after a week or so on insulin with suitable diet, that he insisted on leaving hospital, and I have been unable to trace him

These are by no means brilliant results and I am not convinced that they are any better than they would have been without insulin

Where insulin has very definitely improved, the prognosis is that it gives the patient a much better chance to stand operation if amputation is required

It seems quite probable that if these patients had been having insulin (or thorough dietetic treatment if that by itself was enough) previous to the onset of gangrene, that the gangrene might have been prevented Better still would be earlier treatment to prevent the occurrence of the arterial degeneration without which gangrene would not take place at all

CHAPTER XII

Septic Infections

It has long been known that diabetes may be greatly aggravated by infection, and that on the other hand diabetics are particularly susceptible to at least some infections Perhaps this is most clearly shown in their lack of resistance to the staphylococcus, the causative organism of both boils and carbuncles So prone are some cases to infection [illegible] injection ([illegible] Every time [illegible] with strict antiseptic precautions, the skin being rubbed with ether and then iodine, he developed a large septic spot at the point of puncture The arms became so painful that it was a problem how to carry on By way of experiment I instructed the sister to give the injection in the way I learned from Sir Almroth Wright, viz, by putting a drop of pure lysol on the skin and inserting the needle through the drop We had no more trouble, and the hint may be useful to anyone who comes across a similar case

Carbuncles and boils are by far the commonest infective conditions complicating diabetes The latter are seldom dangerous, and indeed they are

often useful in drawing attention to the necessity of a urinary examination The ordinary treatment of diabetes usually clears up the condition, but it may be supplimented by vaccines Carbuncle on the other hand is a very serious complication, and must be the immediate cause of death in many diabetics Unless treated energetically the patient is apt to go into a state of coma, and as the coma is usually of the post operative type there is little chance of recovery

The treatment is the ordinary one of tonics and stimulants, free opening and scraping away of sloughs The diet should be an easily digested one and contain a fair amount of carbohydrate, while insulin is given in substantial doses, say, 20 units three times a day, controlled as before by the examination of the urine and the blood Enough should be given to bring the urinary sugar down to a good trace, and to bring the blood sugar to a little under 200 mgr, and to get rid of any acidosis If there is much acidosis it is sometimes well to wait for twenty four or thirty six hours before incision and scraping so as to get the patient into better condition In a case recently under my care we did this, and at the end of the time found the patient so much better, and the carbuncle breaking down and discharging so freely that no operation was required

There is no doubt that the intensive use of insulin in this condition hastens resolution and minimises the risk of coma

With regard to the administration of anæsthetics

in diabetic cases Nitrous Oxide, either alone or with oxygen should be chosen I have never seen harm result from its use even when given early in treatment

CHAPTER XIII

Miscellaneous Notes Conclusion.

Ultimate Effect of Insulin Treatment on Sugar Tolerance.

The time that has elapsed since the introduction of insulin is much too short to say whether patients who have been restored to health by its means will keep well and live out the allotted span, and if so, whether the dose can remain stationary, whether it will have to be increased, or whether it can be gradually reduced and finally dispensed with In other words will their sugar tolerance remain stationary, diminish or increase. So far as my series of cases goes the great majority require to keep up the same dose, a fair number have been able to decrease it and only one, Case 6, has had to increase it materially. In addition to Case 9 which has been already mentioned, the following case is another illustration of greatly increased tolerance and incidentally shows the wonderful effects of insulin :—

Case 17 —Boy, aged 17 History of sudden onset of diabetes three weeks before admission. Previously he was in good health but one day was thirsty and felt tired and the following day was too ill to go to work. Condition became rapidly worse in spite of dietetic treatment. On admission, he was thin, pinched, anæmic and miserable looking The urine contained 8 per cent. sugar,

INDEX.

INDEX.